Tubular Filters

A variety of filter requirements can be satisfied by using a Reactel Tubular Filter. These versatile units cover the broad frequency range of 10 MHz to 18 GHz, range in diameters from 1/4" to 1 1/8", and can handle power up to 200 watts in our standard design. All standard tubular filters utilize a low ripple Chebyshev design which offers the best compromise of low loss, low VSWR, and high selectivity. Each filter situation is unique, and the data provided on the following pages offers only a small glimpse of our capabilities. Should a different design become necessary to meet your requirements, we can provide these units with Bessel, Butterworth, Elliptic, Gaussian, or Linear Phase responses. Please contact us so we may design the filter which is a perfect fit for your unique requirement.

Part Numbering System

3 B 1 — 500 — 100 S 1 1
1 2 3 4 5 6 7 8

Part Number Definition:
1- Number of Sections
2- B = Bandpass, L = Lowpass
3- Series Identification
4- Center Frequency (omit for lowpass)
5- 3 dB Bandwidth (bandpass) or
3 dB Cutoff (lowpass)
6- Connector Definition (See Page 31)
7- Input Connector Type
8- Output Connector Type

Tubular Filter Specifications

	Series 0	Series 1	Series 2	Series 3	Series 4
Frequency Range (MHz)	100-18000	100-10000	40-6000	20-3500	10-1000
3 dB BW for Bandpass (% of CF)	1 - 70%	1 - 70%	1 - 85%	1 - 90%	0.5 - 95%
Available Impedances	50Ω & 75Ω	50Ω & 75Ω	50Ω & 75Ω	50Ω & 75Ω	50Ω & 75Ω
Maximum VSWR @ CF	1.5:1	1.5:1	1.5:1	1.5:1	1.5:1
Diameter	0.25″	0.375″	0.50″	0.75″	1.125″
* Standard Input Power	5 Watts	10 Watts	20 Watts	50 Watts	200 Watts
Shock	30G @ 11mS	30G @ 11mS	30G @ 11mS	15G @ 11mS	15G @ 11mS
Vibration	10G	10G	10G	10G	10G
Humidity	up to 95%	up to 95%	up to 95%	up to 95%	up to 95%
Altitude	Space Rated	Space Rated	Space Rated	Space Rated	Space Rated
Temperature	-55° to +125°C	-55° to +125°C	-55° to +125°C	-55° to +125°C	-55° to +125°C

* Higher power is available, please consult the factory.

All Reactel standard tubular filters are designed to a low ripple Chebyshev configuration. Other configurations are available, please call the factory to discuss your specific requirements.

Tubular Bandpass Filter Lengths

Series B0

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
160-200	2.75	3.75	4.75	5.25	6.75	7.75	8.78	9.75	1025
201-300	2.75	3.5	4.25	5.0	5.75	6.5	7.25	8.0	8.75
301-800	2.5	3.25	3.75	4.25	4.75	5.25	6.5	7.25	8.0
801-2000	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5	6.0
2001-4000	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
4001-7000	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5
7001-15000	0.5	0.75	1.0	1.25	1.5	1.75	2.0	2.25	2.5

Series B1

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
100-200	3.0	4.0	5.0	5.5	6.0	6.5	7.0	8.5	9.0
201-300	2.75	3.0	3.75	3.75	4.0	5.0	5.5	6.5	6.75
301-500	2.5	2.75	3.0	3.0	3.75	4.75	5.0	6.25	6.5
501-700	2.0	2.5	3.0	3.0	3.75	4.5	5.0	6.0	6.5
701-1000	1.75	2.0	2.5	2.5	3.5	4.0	4.5	5.0	5.25
1001-2000	1.5	1.75	2.0	2.0	3.0	3.5	3.75	4.0	4.5
2001-3000	1.25	1.5	1.75	1.75	2.5	3.0	3.5	3.75	4.25
3001-7500	1.0	1.25	1.5	1.5	2.25	2.5	3.0	3.5	4.0

Series B2

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
50-70	5.5	8.0	10.0	12.0	14.5	17.0	17.5	18.5	19.5
71-100	3.5	4.5	6.0	8.0	9.75	11.5	13.5	15.5	17.0
101-140	3.0	3.5	5.0	6.5	7.5	8.5	9.5	11.0	12.5
141-200	2.5	3.0	4.25	5.25	6.25	7.0	8.0	9.0	10.0
201-300	2.25	2.75	3.5	4.25	5.0	5.5	6.25	7.0	8.0
301-400	2.0	2.5	3.0	3.5	4.25	5.0	5.5	6.5	7.5
401-700	1.5	2.0	2.5	3.0	3.5	4.5	5.0	6.0	7.0
701-5000	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.25	4.5

Series B3

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
40-50	5.0	7.0	9.0	11.5	14.0	17.0	19.0	21.5	24.0
51-75	4.5	6.5	8.0	9.5	11.5	13.0	15.0	16.0	17.0
76-150	3.0	3.5	4.0	5.5	6.5	8.0	9.0	10.0	11.0
151-300	2.5	3.0	3.5	4.0	5.0	5.5	6.5	7.0	8.0
301-700	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0	7.0
701-2000	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	6.0

Series B4

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
20-40	4.5	6.5	9.0	10.5	13.0	16.0	19.0	22.0	25.0
41-60	4.0	5.0	6.5	8.5	10.0	13.0	15.0	17.0	19.0
61-80	3.5	4.0	5.5	7.0	8.5	9.5	11.0	13.0	14.5
81-200	3.0	4.0	4.5	6.0	7.0	8.0	9.5	11.0	12.0
201-500	3.0	3.5	4.0	5.0	6.0	7.0	8.0	9.0	10.0
501-10000	2.5	3.0	3.5	4.5	5.0	5.5	6.5	7.0	8.0

Tubular Bandpass Weight per Section (oz.)

Series	B0	B1	B2	B3	B4
Weight	0.25	0.50	0.75	1.00	1.50

The lengths and weights shown in these tables are approximate and should only be used as a guide. Reactel reserves the right to alter these dimensions to meet a particular specification.

Tubular Filter Data

Series L0

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
100-200	1.75	2.5	3.25	4.0	4.75	5.5	7.25	8.0	8.75
201-300	1.25	1.75	2.25	2.75	3.25	3.75	4.25	4.75	5.25
301-800	1.0	1.5	1.75	2.0	2.25	2.5	3.0	3.5	4.0
801-2000	1.0	1.5	1.75	2.0	2.25	2.5	2.75	3.5	3.75
2001-4000	1.0	1.5	1.75	2.0	2.25	2.5	2.5	3.0	3.5
4001-7000	0.75	1.0	1.75	1.5	1.75	2.0	2.25	2.5	3.0
7001-10000	0.5	0.75	1.0	1.25	1.5	2.0	2.25	2.5	2.75
10001-18000	0.5	0.65	0.75	0.9	1.0	2.0	2.25	2.5	2.75

Series L1

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
100-200	2.5	3.5	4.5	5.5	6.5	7.5	8.5	9.5	10.0
201-400	1.5	2.0	3.0	3.5	4.0	4.5	5.5	6.5	7.0
401-600	1.5	2.0	2.5	3.0	3.5	4.5	4.75	5.0	5.5
601-1000	1.5	2.0	2.25	2.5	3.0	4.0	4.25	4.5	5.0
1001-2000	1.0	1.5	1.75	2.5	2.75	3.25	3.5	4.0	4.5
2001-3000	1.0	1.5	1.75	2.0	2.5	3.0	3.25	3.5	4.0
3001-4000	0.75	1.25	1.5	2.0	2.5	2.75	3.0	3.25	3.5
4001-10000	0.75	1.0	1.25	1.75	2.25	2.5	3.0	3.25	3.5

Series L2

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
40-50	4.0	6.0	8.5	10.5	12.5	15.0	17.5	18.0	19.5
51-70	3.0	5.0	6.5	8.5	10.5	12.5	15.0	16.0	19.0
71-100	2.5	4.0	5.5	6.5	8.0	10.0	11.5	13.0	14.5
101-250	2.0	3.5	4.5	5.5	6.5	7.0	7.5	8.0	8.5
251-500	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
501-1000	1.25	1.5	2.25	2.5	3.0	3.5	4.0	4.5	5.0
1001-2500	1.0	1.5	2.0	2.25	2.5	3.0	3.5	4.0	4.5
2501-6000	0.75	1.0	1.5	2.0	2.5	2.75	3.0	3.5	4.0

Series L3

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
20-40	5.0	8.0	11.5	15.5	18.0	21.5	25.0	26.5	28.0
41-60	3.0	6.0	8.0	10.5	13.0	15.0	17.5	21.0	24.0
61-90	2.5	4.5	6.0	8.0	10.0	11.5	12.5	14.5	16.0
91-150	1.5	3.0	4.5	5.0	6.0	6.5	7.5	8.0	9.0
151-500	1.5	3.0	3.5	4.5	5.5	6.0	6.5	7.0	8.0
501-1000	1.5	2.5	3.5	4.5	5.0	5.25	6.0	6.5	7.5
1001-3500	1.0	2.5	3.0	3.5	4.5	4.75	5.0	6.0	6.5

Series L4

3 dB Cutoff (MHz)	Number of Sections 2	3	4	5	6	7	8	9	10
10-20	7.0	10.5	13.5	17.5	20.5	23.0	26.0	28.5	30.0
21-35	5.0	7.0	9.5	13.0	15.0	17.0	21.0	22.0	24.5
36-60	4.0	5.5	6.5	7.5	10.0	11.5	13.0	14.5	16.0
61-150	3.5	4.0	4.5	5.5	7.0	8.0	9.0	10.0	11.0
151-400	3.0	3.5	4.0	5.0	5.5	6.5	7.5	8.0	8.5
401-1000	2.5	3.0	3.5	4.5	5.5	6.5	7.0	7.5	8.0

Tubular Lowpass Weight per Section (oz.)

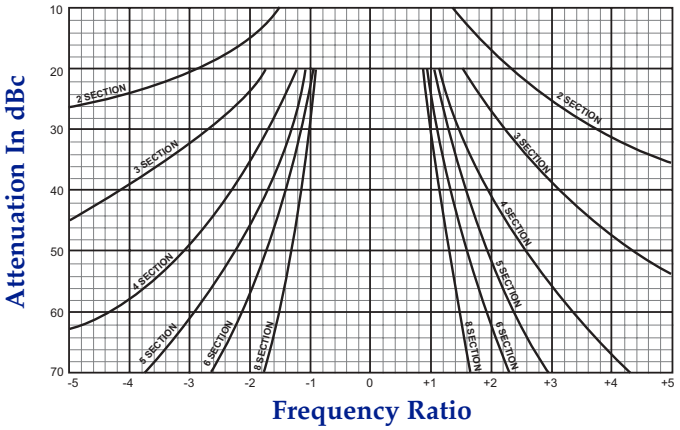
Series	L0	L1	L2	L3	L4
Weight	0.25	0.50	0.75	1.00	1.50

The lengths and weights shown in these tables are approximate and should only be used as a guide. Reactel reserves the right to alter these dimensions to meet a particular specification.

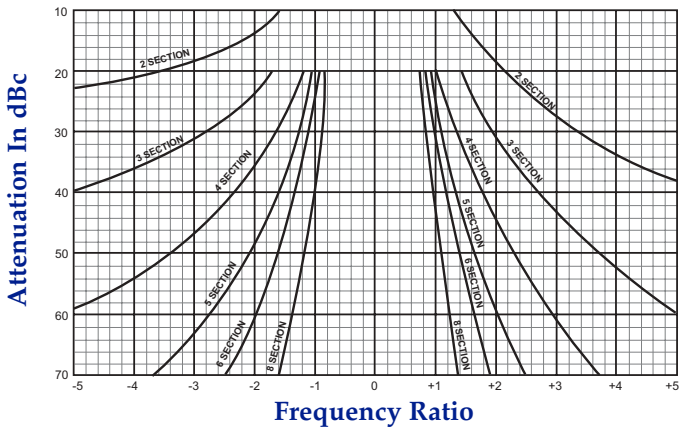
Tubular Filter Attenuation Curves

Bandpass Filter Attenuation Curves

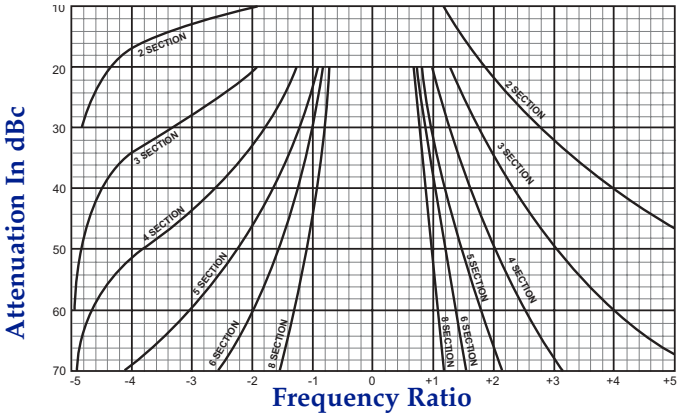
2 - 5% 3 dB Bandwidth



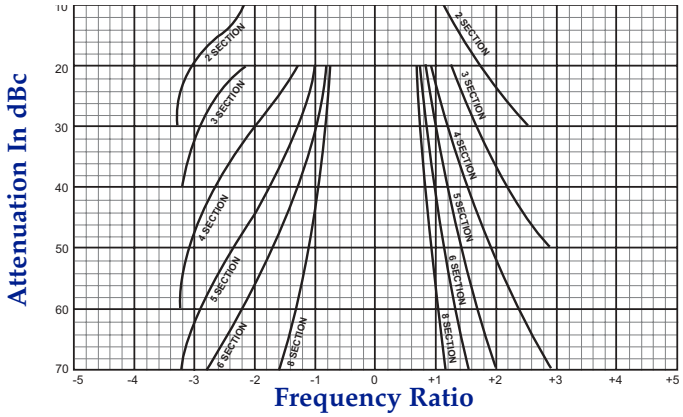
5 - 10% 3 dB Bandwidth



10 - 20% 3 dB Bandwidth



20 - 30% 3 dB Bandwidth



These attenuation curves are normalized to be reasonably representative of performance characteristics for filters with 3 dB bandwidths approximating the percentages shown. For more precise values at specific frequency points, please contact Reactel.

The rejection for bandpass filters can be determined from the curves. Calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency - Center Frequency}}{\text{3 dB Cutoff Frequency}}$$

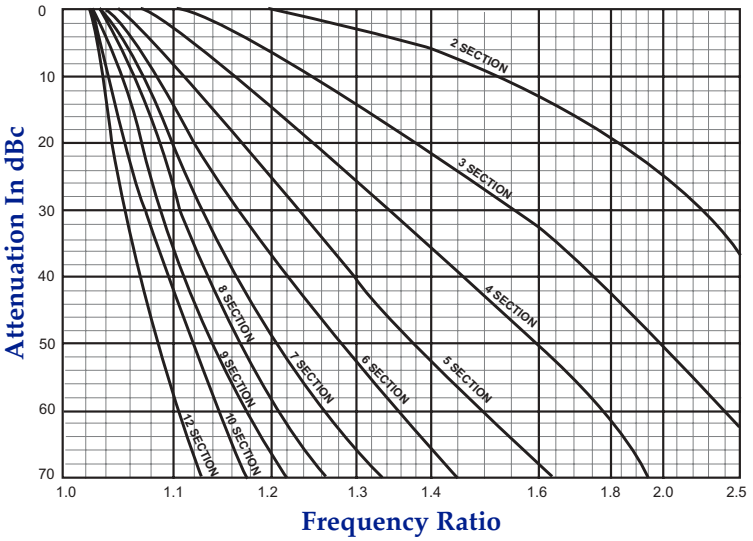
Example:

Center Frequency = 1000 MHz
3 dB Bandwidth = 150 MHz
Number of Sections = 6
Reject Frequencies = 800 & 1200 MHz
% Bandwidth = 15%

$$\text{Frequency Ratio} = \frac{800 - 1000}{150} = -1.33$$

Rejection from Curve = 42.8 dB

Tubular Lowpass Attenuation Curves



The rejection of lowpass filters can be determined from the attenuation curves. For frequencies above the 3 dB cutoff, calculate the frequency ratio as follows:

$$\text{Frequency Ratio} = \frac{\text{Rejection Frequency}}{\text{3 dB Cutoff Frequency}}$$

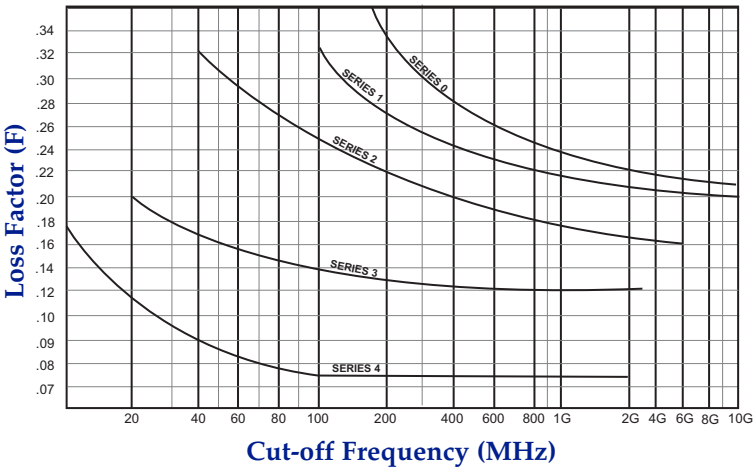
Example:

Rejection Frequency = 196 MHz
3 dB Cutoff Frequency = 150 MHz
No. of Sections = 6

$$\text{Frequency Ratio} = \frac{196}{150} = 1.3$$

Rejection from Curve = 53.5 dB

Insertion Loss Curves



Where F = Loss Factor
And N = Number of Sections
Insertion Loss = FN + .05

Example:

Number of Sections = 5
Series = 2
Cut-off Frequency = 1500 MHz
Insertion Loss = FN + .05
Insertion Loss = .17 x 5 + .05
Insertion Loss = .9 dB max up to 90% of 3 dB cutoff

The curves on this page are theoretical values only. For more precise values at specific frequency points, please contact Reactel.

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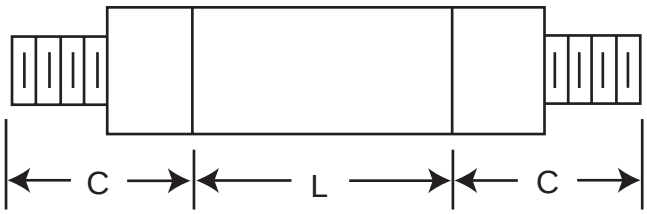
Tubular Filter Data

Length Definition



L = Filter Length (see tables on pages 27 & 28.)
C = Connector Length (see table below)

Connector Length "C"

Connector Type	Connector Code	Type M/F	Filter Series 0	1	2	3	4
SMA	S	2/1	0.72/0.60	0.75/0.75	0.75/0.75	0.75/0.75	0.90/0.75
SMA Right Angle	SR	2/1	N/A	0.60/0.60	0.60/0.60	0.60/0.60	0.60/0.60
SMA Flush	SF	2/1	0.75/0.75	0.75/0.75	0.75/0.75	0.75/0.75	0.90/0.75
SMB (Snap On)	M	2/1	0.60/0.60	0.75/0.75	0.75/0.75	0.75/0.75	0.75/0.75
SMC (Screw On)	O	2/1	0.60/0.60	0.75/0.75	0.75/0.75	0.75/0.75	0.75/0.75
BNC	B	2/1	N/A	1.10/1.10	1.00/1.00	1.42/1.42	1.42/1.42
TNC	T	2/1	N/A	1.10/1.10	1.00/1.00	1.42/1.42	1.42/1.42
Type N	N	2/1	N/A	1.35/1.37	1.25/1.27	1.67/1.70	1.67/1.70
PC Pin	P	---	0.50	0.60	0.60	0.60	0.75
RG 188 Cable	G	---	TBD	TBD	TBD	TBD	TBD

3 dB BW Tolerance
(Unless Otherwise Specified)

3 dB BW % of f_0	Tolerance on % BW
1 - 5%	+0.5 to -0%
5.1 - 25%	+2.5 to -0%
25.1 - 55%	+4.5 to -0%
55.1% - and up	+5.5 to -0%

Insertion Loss v. 1.5:1 VSWR BW And Number of Sections

I.L. dB	Number of Sections 2	3	4	5	6 & up
0-3	50-55%	65-75%	75-80%	80-90%	95% & up
3-4	55-65%	75-82%	83-90%	89-95%	95% & up
4-5	60-70%	80-95%	90% & up	95% & up	95% & up

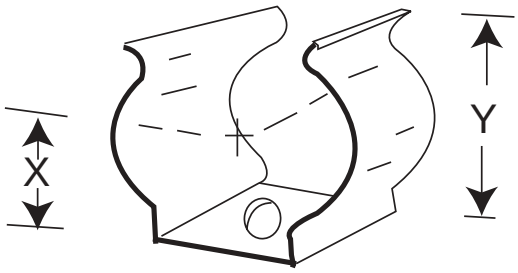
Tubular Filter Mounting Options

The "Type S Spring Clip" is a light to medium duty fastening method, and is good for most all applications.

For more rugged environments the "Type R High Shock Bracket" would be appropriate.

Type S-Spring Clip

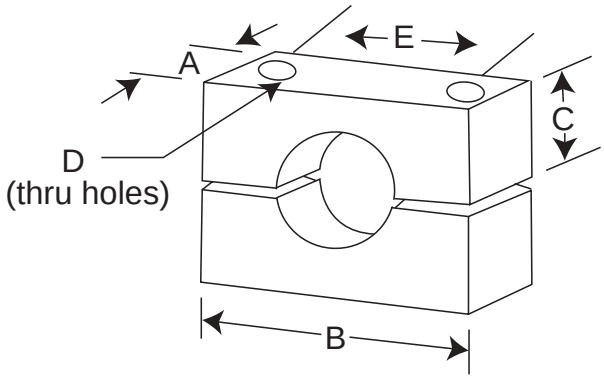
Series	X	Y	Material
0	0.30	0.50	Phos-Bronze
1	0.32	0.50	Plastic
2	0.45	0.75	Phos-Bronze
3	0.50	0.80	Plastic
4	0.62	1.15	Phos-Bronze
5	0.62	1.15	Phos-Bronze



All tubular filters ordered in quantities of 10 or fewer are supplied with Type S Spring Clips free of charge. For larger quantities, please consult the factory.

Type R High Shock Bracket

Series	A	B	C	D	E
0	0.12	0.50	0.22	0.093	0.375
1	0.25	0.87	0.35	0.113	0.620
2	0.25	1.00	0.47	0.144	0.750
3	0.37	1.50	0.70	0.169	1.125
4	0.50	2.00	1.00	0.193	1.755
5	0.50	2.00	1.00	0.193	1.755

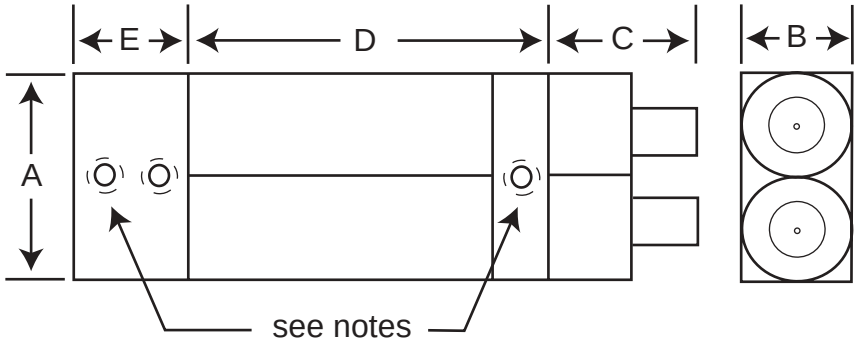


Type R High Shock Brackets can be supplied with tubular filters for an additional charge, please consult the factory for a price quote.

Special Tubular Filters

There are occasions where our customers have space and form factor limitations which preclude the use of a standard tubular filter configuration. Tubular filters can, however, be designed and packaged in different forms and shapes in order to accommodate most any mounting and packaging requirement. Some advantages of adapting a tubular filter to a special configuration, are simplicity, reliability, and cost effectivness. The most common method for reducing the length of a tubular filter up to 1500 MHz is by folding the unit. The standard folding dimensions are given below.

Folded Tubular Filter



Dimension Code	Series 0	Series 1	Series 2	Series 3	Series 4
A	0.5	0.75	1.01	1.5	2.25
B	0.25	0.37	0.5	0.75	1.25
C	*	*	*	*	*
D	** 0.65 x L	** 0.65 x L	** 0.65 x L	** 0.65 x L	** 0.65 x L
E	0.25	0.37	0.5	0.75	0.75

* See table of Connector Lengths on page 31.
** See table of Tubular Filter Lengths on pages 27 & 28.

Threaded holes for mounting are as follows:
Series 0: 2-56 Series 1: 2-56 Series 2: 4-40 Series 3: 6-32 Series 4: 8-32

Reactel reserves the right to change or modify the folding dimensions to suit the application.